Homework #6: Phys 3344: Prof. Olness Fall 2018

Due 2 October, 2018

1) Find the shortest distance between two points located on the surface of a cylinder.

2) Solve the brachistochrone as outline in the book. Add in all the intermediate steps. (The book leaves out quite a bit.) Plot the resulting curves.

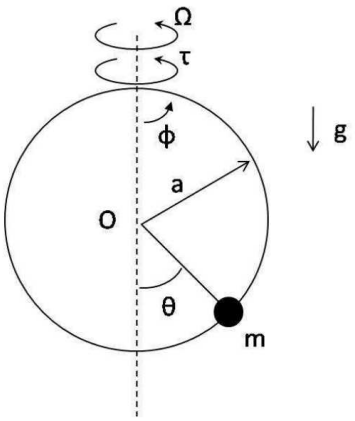
3) Consider light passing from one medium to another with indices of refraction of {n1,n2}. Use Fermat's principle to minimize the time and find the resulting law of refraction.

4) Consider a mass m sliding down an incline of angle θ a distance d (along the incline) with a coefficient of friction of μ. Find the velocity v at the bottom of the ramp.
Do this using the Lagrange equations.

5) Atwood Machine: Consider an Atwood machine with masses m1 and m2 and lengths x1+x2=L. The pulley is massless and frictionless. Compute the acceleration of each mass.
a) Do this using either forces or energy. Also find the tension T in the string.
b) Do this using the Lagrange equations of x1, and substitute x2=L-x1.
c) Do this using the Lagrange equations of {x1,x2} and use a Lagrange multipler λ.

6) A uniform hoop of mass m and radius b rolls without slipping on a fixed cylinder of radius a. The only external force is gravity. If the smaller cylinder starts rolling from rest on top of the larger cylinder, find (using Lagrange multipliers) the point at which the hoop falls off the cylinder.

7) A bead on a circular hoop is spinning at frequency w. Find all equilibrium points, and identify if they are stable or unstable. (It could be w dependent.) For the stable points, compute the frequency of small oscillations.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